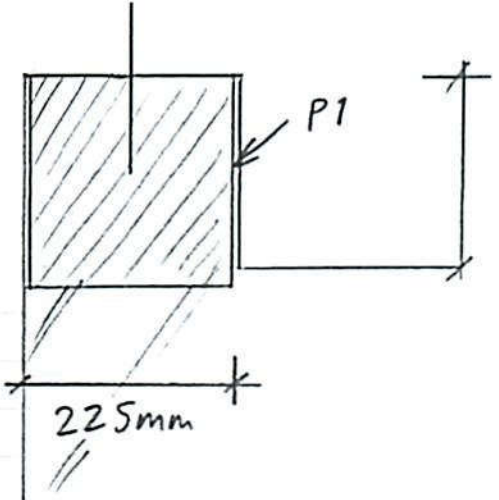


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STRUCTURAL CALCULATIONS

SAMPLE PROJECT
SITE ADDRESS REMOVED

Registered in England Company No. 17472917

BEAM CALCS LIMITED

STRUCTURAL DESIGN PACK

STATEMENT OF COMPETENCE AND DESIGN RESPONSIBILITY

1. Regulatory Framework and Design Standards

The structural calculations, loading assessments, member designs and associated structural details contained within this design pack have been prepared in relation to the applicable structural requirements of Part A (Structure) of the Building Regulations 2010, as amended, in England.

The design has been undertaken using the relevant British Standards, Eurocodes and applicable UK National Annexes identified in the accompanying calculations, as appropriate to the structural elements and design assumptions concerned.

The design considers structural strength, stability, serviceability and robustness to the extent relevant to the agreed scope of works.

The calculations and details are based on the project information, drawings, dimensions, site observations and design assumptions identified within this design pack. The design addresses the structural elements expressly identified in the calculations and associated details and does not constitute certification of the compliance of the entire building or project.

2. Structural Designer – Competence and Qualifications

The structural engineering calculations, specifications and details contained within this design pack have been prepared by Kevin Taylor ACABE, acting on behalf of Beam Calcs Limited.

Relevant qualifications, professional membership and experience include:

- **Professional membership:** Associate Member of the Chartered Association of Building Engineers (ACABE).
- **Academic qualification:** Higher National Certificate (HNC) in Civil Engineering.
- **Professional experience:** Over 30 years' professional experience in structural design, detailing, analysis and CAD production, across residential, commercial, public-sector and infrastructure projects.
- **Residential structural design:** Experience in domestic structural alterations, including steel beam design, padstones, load-bearing wall removals and superstructure elements associated with extensions, loft conversions and similar works.
- **Local authority experience:** Former Senior Technician with Derby City Council, with experience in structural design, structural calculations, checking and review of engineering information, CAD production and design-team coordination.
- **Structural checking experience:** Experience reviewing and checking structural calculations and technical information submitted by external engineers in connection with Building Regulations requirements.

Beam Calcs Limited undertakes design work only where it has the skills, knowledge, experience and organisational capability necessary for the work concerned. In accordance with the applicable competence requirements in Part 2A of the Building Regulations 2010, including regulation 11F, the company will not accept or continue an appointment if the required competence or resources are unavailable.

3. Design Responsibility, Information and Site Variations

This design pack has been prepared specifically for the project and the scope of works identified within it.

The calculations and structural details are based on the dimensional information, drawings, site observations, loading information, material specifications and other design assumptions identified in this design pack.

Where information has been supplied by the client, architect, architectural designer, contractor or another third party, Beam Calcs Limited is entitled to rely on that information as the basis of the design, except where verification is expressly included within the agreed scope of services.

Where material discrepancies are identified between the design information and the conditions encountered on site, or where the proposed works differ materially from those shown in this design pack, the affected structural design must be referred to Beam Calcs Limited for review before the relevant works proceed.

No alteration, substitution or modification to a structural element covered by this design pack should be made without an appropriate review by a suitably competent person. Where a proposed change affects the design prepared by Beam Calcs Limited, the company must be consulted before the works in question proceed.

The contractor remains responsible for checking site dimensions, setting out, construction sequencing, workmanship and the implementation of appropriate temporary works.

4. Professional Indemnity Insurance

Where the relevant policy is in force, Beam Calcs Limited maintains professional indemnity insurance in connection with its structural engineering services, subject to the terms, conditions, exclusions, excesses and limits of the applicable policy.

Details and evidence of the current insurance arrangements can be provided to the client, appointed Principal Designer or relevant Building Control Body upon reasonable request.

The existence of professional indemnity insurance does not constitute a guarantee of Building Regulations approval or extend the agreed scope of the company's services.

5. Dutyholder Role and Appointment Limits

Beam Calcs Limited is appointed as structural designer for the structural engineering elements expressly identified within the agreed scope of services.

Unless separately agreed in writing, Beam Calcs Limited does not undertake the role of:

- Overall Principal Designer under the Building Regulations or the Construction (Design and Management) Regulations 2015.
- Principal Contractor or contractor.
- Architect or architectural designer.
- Building Control Body or registered building inspector.
- Designer responsible for disciplines outside the agreed structural engineering scope.

Where acting as a designer under the Building Regulations and/or the Construction (Design and Management) Regulations 2015, Beam Calcs Limited will fulfil the statutory duties applicable to that role. These include undertaking design work within its competence, cooperating and communicating with relevant dutyholders, and providing appropriate structural design information for coordination with the wider project.

Where applicable to the appointment and required for the project, Beam Calcs Limited will provide relevant information concerning its design and the fulfilment of its duties. Any formal declaration or compliance documentation will be provided where applicable to its role and within the scope of its appointment.

The appointment of Beam Calcs Limited as structural designer does not transfer to the company the responsibilities of the client, Principal Designer, Principal Contractor, contractor or other dutyholder.

6. Scope of Structural Design Services

Beam Calcs Limited principally undertakes structural calculations and design for alterations to individual domestic residential houses of up to three storeys, including:

- Removal of load-bearing walls.
- Steel beam design.
- Steel-to-steel connections, where expressly included within the agreed scope.
- Padstone and local bearing design.
- Structural elements associated with domestic extensions.
- Structural elements associated with loft conversions.
- Other agreed superstructure alterations and associated structural calculations and drawings.

The company specialises in superstructure design. Foundation and substructure design, assessment of existing foundation adequacy, ground investigations and ground condition assessments are excluded unless expressly agreed in writing and confirmed as falling within the company's competence and insurance arrangements.

Projects involving unusual structural arrangements, significant structural complexity, specialist engineering disciplines or work outside the company's normal domestic scope will be assessed individually before an appointment is accepted. Such work may require input from an appropriately competent specialist.

Higher-risk building work and projects outside the company's stated scope will not be undertaken unless separately assessed, expressly agreed, and confirmed to fall within the company's competence, resources, and insurance arrangements.

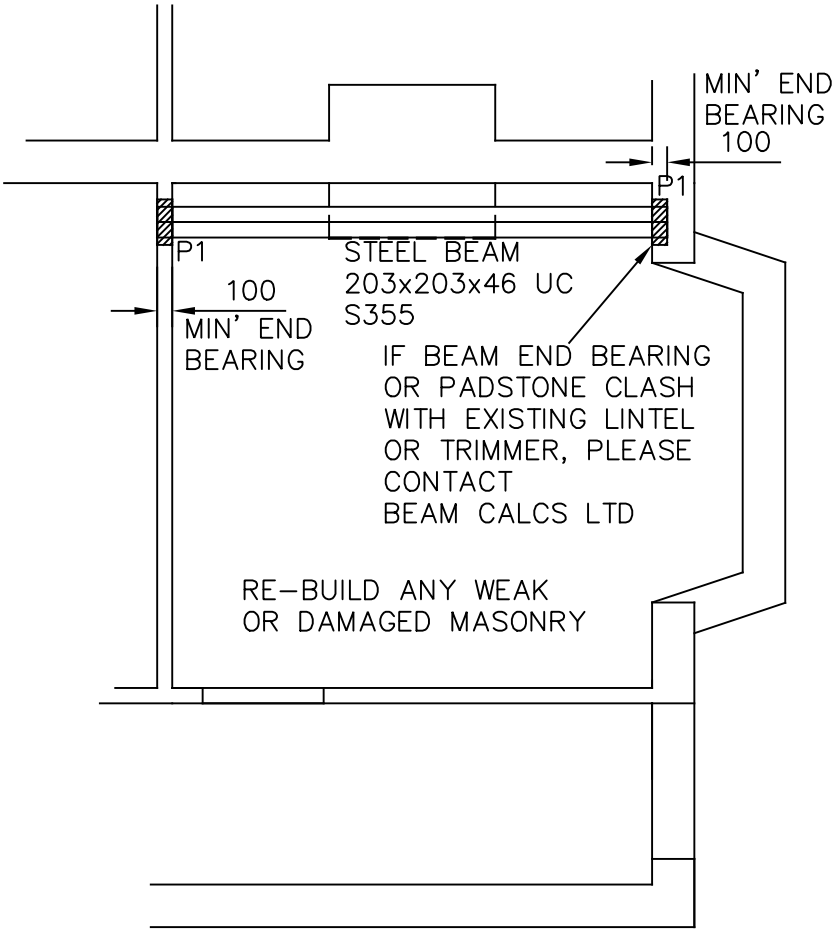
This statement describes the competence and design responsibilities relevant to the structural design pack. The agreed scope of services for the individual project is set out in the applicable quotation and Terms of Engagement.

Prepared by:

Kevin Taylor ACABE
Beam Calcs Limited

Structural Engineering Design & Calculations

MEASURE ON SITE PRIOR
TO ORDERING STEEL BEAM



PADSTONE P1 =
DENSE CONCRETE WITH
A MINIMUM COMPRESSIVE
STRENGTH OF 40N/mm²
300mm LONG x 100mm WIDE
x 140mm DEEP

REF NUMBER: 2026-001

GROUND FLOOR PLAN
SHOWING BEAM ABOVE

HEALTH AND SAFETY & GENERAL NOTES

Beam Calcs Limited

1. CDM 2015 – Construction (Design and Management)

The Construction (Design and Management) Regulations 2015 (CDM 2015) apply to construction work, including domestic residential projects.

- **Scope of appointment:** Beam Calcs Limited is appointed to provide structural design and calculation services only for the structural elements identified in the quotation or project instruction. Unless expressly agreed in writing, the company does not undertake the role of Principal Designer under CDM 2015 or under the Building Regulations. Its normal scope is limited to individual domestic residential houses of up to three storeys. Flats, apartments, multi-occupancy residential schemes and commercial properties are excluded unless separately agreed in writing.
- **Designer duties:** When acting as a designer, Beam Calcs Limited will fulfil the statutory duties applicable to that role and will undertake design work only within its competence, skills, knowledge, experience and available resources.
- **Project coordination:** The client and other relevant dutyholders must ensure that the appointments and arrangements required by law are in place. Where appointed, the Principal Designer coordinates health and safety during the pre-construction phase. Beam Calcs Limited will cooperate with relevant dutyholders and provide structural design information reasonably required for coordination of the project.
- **Risk management:** In developing its structural design, Beam Calcs Limited will consider foreseeable health and safety risks arising from the design and, so far as reasonably practicable, seek to eliminate, reduce or control those risks. Relevant information identified through the design will be communicated to the client or appropriate project dutyholders.

2. Building Regulations and Building Control

- **Design scope:** The structural design is prepared with regard to the applicable structural requirements of the Building Regulations in England and the design standards identified in the calculations. The design pack covers only the structural elements expressly identified and does not certify the compliance of the entire building or project.
- **Applications and notifications:** The client and relevant project dutyholders are responsible for ensuring that the necessary Building Regulations procedures, applications, notices and approvals are addressed before work proceeds, as applicable to the project.
- **Limits of review:** Beam Calcs Limited's calculations and details do not constitute Building Control approval and do not cover architectural design, building services or other disciplines unless expressly included in the agreed scope.
- **Design variations:** Where a proposed change affects a structural element designed by Beam Calcs Limited, the change must be referred to the company for review before the affected work proceeds. Building Control comments or acceptance do not remove the need to check that the work is carried out in accordance with the relevant design and legal requirements.

3. Temporary Works and Construction

- **Handling and lifting:** Beams and other structural components may be heavy and may require mechanical lifting equipment, suitable access, and a planned method of handling and installation.
- **Construction safety:** The contractor is responsible for planning and carrying out the construction work safely, including site safety, construction methodology and the provision of suitable temporary works, except to the extent that any such service is expressly included in Beam Calcs Limited's appointment.
- **Propping and support:** Before any load-bearing wall, beam, column or other structural element is altered, removed or demolished, the existing structure must be adequately supported. Temporary supports must be appropriately designed, installed, inspected and maintained by competent persons.
- **Stability and sequence:** The contractor must determine a safe construction sequence and method of work and maintain the stability of the structure throughout the works. Relevant HSE and industry guidance should be followed. Beam Calcs Limited's permanent-works design must not be treated as a design for temporary support unless expressly stated.

4. Structural Fire Protection

- **Required performance:** Where fire protection to structural steelwork is required, the required fire-resistance period and method of protection must be established for the project in accordance with the applicable Building Regulations, Approved Document B and the wider building design.
- **Installation:** Fire protection should use a suitable proprietary system or construction capable of achieving the required performance and must be installed in accordance with the relevant manufacturer's tested or assessed details and instructions.
- **Verification:** The contractor must ensure that the specified fire protection is correctly installed. Fire strategy and the design of fire protection systems are excluded from Beam Calcs Limited's scope unless expressly included in writing.

5. Existing Superstructure, Masonry and Foundations

- **Foundation and ground exclusions:** Beam Calcs Limited's normal service is limited to superstructure design. Foundation and substructure design, ground investigations, ground-condition assessments and assessment of the adequacy of existing foundations are excluded unless expressly agreed in writing and confirmed as within the company's competence and insurance arrangements. No foundation capacity should be assumed to have been verified by this design pack unless expressly stated.
- **Foundation-related loads:** Where the proposed works introduce modified or additional loads, the client must arrange for any necessary assessment of the existing foundations by a suitably competent professional. Building Control may require further information, but its involvement should not be assumed to constitute an engineering assessment of foundation capacity. If foundation adequacy is material to the proposed works and has not been established, the affected works should not proceed until the issue has been appropriately resolved.
- **Existing masonry:** Existing masonry supporting the proposed structural works must be suitable for the loads imposed. The contractor must check the visible condition and construction of the relevant bearing areas. Weak, cracked, deteriorated or otherwise unsuitable masonry must be referred for assessment and appropriate remedial work before the structural works proceed.
- **Unexpected conditions:** If substandard masonry, hidden cavities, unexpected defects or other material differences are found at or near bearing positions, the contractor must stop the affected work and notify Beam Calcs Limited before proceeding where the design may be affected.
- **Padstones and bedding:** Where padstones or bedding mortar are specified, temporary supports must remain in place until the padstones, mortar and supporting construction have achieved sufficient strength to carry the relevant loads safely. The contractor must follow the specified materials, installation details and appropriate curing requirements.
- **Discrepancies:** Differences between assumed and actual construction—including wall thicknesses, spans, timber sizes, materials or bearing conditions—must be referred to Beam Calcs Limited where they may affect the design. The affected design must not be relied upon until the discrepancy has been reviewed.

6. Electrical and Other Non-Structural Work

- **Electrical work:** Electrical work is outside Beam Calcs Limited's structural design scope unless expressly stated otherwise. It must be designed, installed, inspected and tested by suitably competent persons in accordance with applicable legislation and standards, including Part P of the Building Regulations and BS 7671 where relevant.
- **Other disciplines:** Unless expressly included in the quotation, the structural calculations do not provide a specification or design for the complete building works and do not cover architectural design, drainage, mechanical or electrical services, fire strategy, or other specialist disciplines.

7. General Structural Design Notes

- **Design information:** The calculations and design are based on the project information, dimensions, loading data, drawings, site observations and assumptions identified in the design pack. Information supplied by the client or other parties is relied upon unless verification is expressly included in the agreed scope.
- **Site verification:** Dimensions shown are design dimensions unless expressly identified as site-measured. The contractor must verify relevant site dimensions and conditions before ordering, fabricating or installing structural members. This includes beam lengths, bearing dimensions, wall thicknesses, opening sizes, floor levels and other critical dimensions.
- **Unverified conditions:** Where actual dimensions, materials or site conditions differ materially from those assumed in the design pack, the affected design must be referred to Beam Calcs Limited for review before the relevant work proceeds.
- **Workmanship and installation:** The contractor remains responsible for setting out, workmanship, installation, construction methods, and ensuring that the work is carried out by competent persons in accordance with the design and applicable requirements.
- **Scope and reliance:** These notes must be read with the project-specific calculations, drawings, quotation and Terms of Engagement. They do not extend Beam Calcs Limited's appointment beyond the agreed scope or transfer the responsibilities of other project dutyholders.

Beam Calcs Limited 9 Hollies Farm Drive, Horsley Woodhouse, Derbyshire 01332 410066 www.beamcalcsltd.com info@beamcalcsltd.com	Sample project ? address removed	SAMPLE
	Sample client	Date 14 Oct 2026

Steel Beam Design

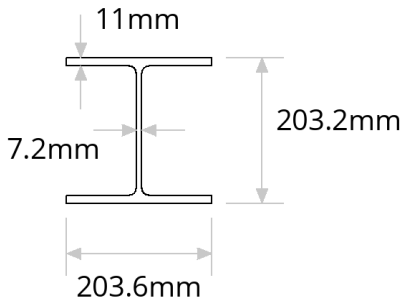
To Eurocode BS EN 1993-1-1/NA:2008

Design summary

	Resistance / Limit	Applied / Actual	Utilisation	
Shear	**347** kN	**24.1** kN	**7 %**	**OK**
Bending moment	**176** kNm	**38.9** kNm	**22 %**	**OK**
Buckling	**154** kNm	**38.9** kNm	**25 %**	**OK**
Total deflection	**16.5** mm	**2.7** mm	**17 %**	**OK**
Deflection due to variable actions	**9.2** mm	**0.2** mm	**2 %**	**OK**

Section details

Type	**Universal column**
Section	**203 x 203 x 46 UC**
Steel grade	**S355**
Width	b = **204** mm
Depth	h = **203** mm
Web thickness	t_w = **7.2** mm
Flange thickness	t_f = **11** mm
Root radius	r = **10.2** mm
Mass per metre	w = **46.1** kg/m



Span and restraints

Effective span	L = **3,300** mm
Buckling length	L_{cr} = **3,300** mm

Deflection limits

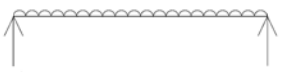
Variable action deflection limit	Δ_Q = L / 360 = **9.17** mm
Total deflection limit	Δ_{G+Q} = L / 200 = **16.5** mm

Safety factors

Partial factor for permanent actions	γ_G = **1.35**
Partial factor for variable actions	γ_Q = **1.5**

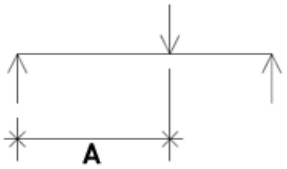
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	Sample client	Date 14 Oct 2026

Loading details



Self weight

Permanent action	SW = w × 9.81 / 1000 = **0.452** kN/m



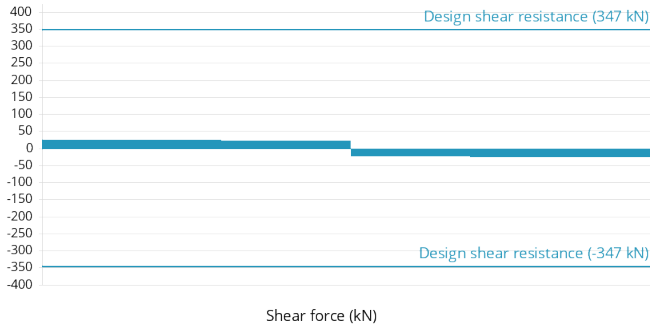
Load 1: Point load - Chimney, 22 kN/m3 x 1.1 m x 0.37m x 5 m x 30% void = 32 kN

Distance to point load, A	A = **1.65** m
Permanent action	G_1 = **32** kN
Variable action	Q_1 = **2** kN

Reactions

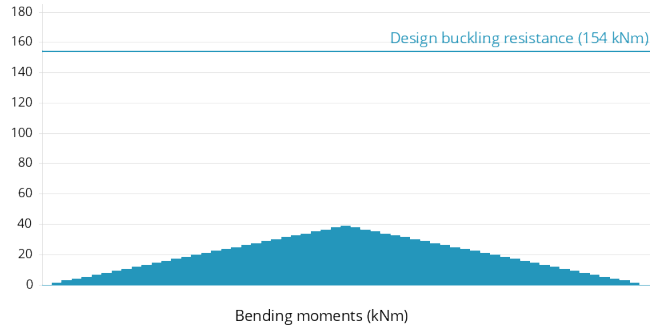
	Permanent (unfactored)	Variable (unfactored)	Total (unfactored)	Total (factored)
Left reaction	**16.7** kN	**1** kN	**17.7** kN	**24.1** kN
Right reaction	**16.7** kN	**1** kN	**17.7** kN	**24.1** kN

Design shear force



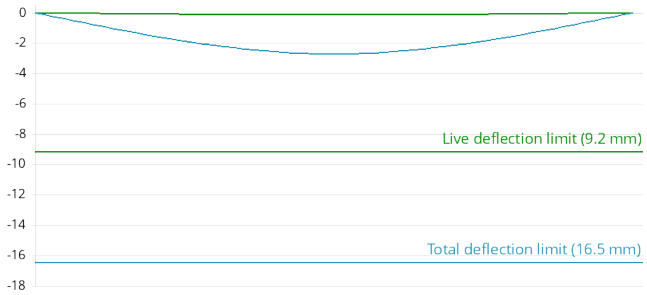
Design shear force	V_{Ed} = **24.1** kN	
Design shear resistance	$V_{c,Rd}$ = **347** kN	
Utilisation	V_{Ed} / $V_{c,Rd}$ = **7** %	**OK**

Design bending moment



Design bending moment, major axis	M_{Ed} = **38.9** kNm	
Design resistance for bending	$M_{c,Rd}$ = **176** kNm	
Bending utilisation	M_{Ed} / $M_{c,Rd}$ = **22** %	**OK**
Design resistance for buckling	$M_{b,Rd}$ = **154** kNm	
Buckling utilisation	M_{Ed} / $M_{b,Rd}$ = **25** %	**OK**

Deflection



Live load deflection (green) and total load deflection (blue) in mm

Variable action deflection limit	Δ_Q = **9.2** mm	
Variable action deflection	δ_Q = **0.2** mm	**OK**
Total deflection limit	Δ_{G+Q} = **16.5** mm	
Total deflection	δ_{G+Q} = **2.7** mm	**OK**

Section properties

Elastic modulus - major axis, yy	W_{el} = **450** cm^3	
Plastic modulus - major axis, yy	W_{pl} = **497** cm^3	
Second moment of area - major axis, yy	I_y = **4,570** cm^4	
Second moment of area - minor axis, zz	I_z = **1,550** cm^4	
Warping constant	I_w = **0.143** dm^6	
Torsional constant	I_T = **22.2** cm^4	
Area of section	A = **5,870** mm^2	

Factors and design values of material coefficients (EN 1993-1-1:2005 and National Annex)

Young's modulus of elasticity	E = **210,000** N/mm^2	cl.3.2.6
Poisson's ratio in elastic stage	v = **0.3**	cl.3.2.6
Shear modulus	G_s = **81,000** N/mm^2	cl.3.2.6
Partial factor for resistance of cross-sections	γ_{M0} = **1**	cl.6.1(1)B / BS-EN NA
Partial factor for resistance to instability	γ_{M1} = **1**	cl.6.1(1)B / BS-EN NA
Factor for shear area	η = **1**	EN 1993-1-5:2006 cl.5.1(2) / BS-EN NA
Limiting non dimensional slenderness ratio	$\bar{\lambda}_{LT,0}$ = **0.4**	cl.6.3.2.3(1) / BS-EN NA
Beta factor for buckling reduction factor calculation	β = **0.75**	cl.6.3.2.3(1) / BS-EN NA

Yield strength

Nominal yield strength for S355 grade and nominal section thickness 11.00 mm	f_y = **355** N/mm^2	Tata blue book

Section classification (EN 1993-1-1:2005 cl.5.5)

Epsilon	ε = **0.814**	EN 1993-1-1:2005 Table 5.2
Flange ratio for local buckling	c_f / t_f = **8**	
Flange ratio limit for class 1	9 ε = **7.32**	Table 5.2 (sheet 2 of 3)
Flange ratio limit for class 2	10 ε = **8.14**	Table 5.2 (sheet 2 of 3)
Flange class	$Class_f$ = **2**	
Web ratio for local buckling	c_w / t_w = **22.3**	
Web ratio limit for class 1	72 ε = **58.6**	Table 5.2 (sheet 1 of 3)

Web class	$Class_w$ = **1**	
Section class	Class = **2**	

Shear resistance (EN 1993-1-1:2005 cl.6.2.6)

Height of web	h_w = **181** mm	
Shear area for I and H sections	A_v = **1,690** mm^2	cl.6.2.6 (3)
Design shear resistance	$V_{pl,Rd}$ = **347** kN	eq (6.18)

Shear buckling (EN 1993-1-5:2006 cl.5)

The shear buckling resistance for webs should be verified according to Section 5 of EN 1993-1-5 if $(h_w / t_w) > (72 \varepsilon / \eta)$

Web ratio for shear buckling	h_w / t_w = **25.2**	EN 1993-1-5:2006 cl.5.1 (2)
Shear buckling limit	$72 \varepsilon / \eta$ = **58.6**	EN 1993-1-5:2006 cl.5.1 (2)

$(h_w / t_w) <= (72 \varepsilon / \eta)$ therefore shear buckling calculation not required

Bending resistance (EN 1993-1-1:2005 cl.6.2.5)

The shear force (24 kN) is less than half of the plastic shear resistance (347 kN / 2 = 174 kN), therefore its effect on moment resistance may be neglected.

Class 2 section, therefore use plastic modulus	W_{pl} = **497,000** mm^3	
Design bending resistance	$M_{c,Rd}$ = **176** kNm	eq (6.13)

Design buckling resistance (EN 1993-1-1:2005 cl.6.3.2)

C1 factor	C1 = **1**	
Shear modulus of elasticity	G_s = **81,000** N/mm^2	cl.3.2.6 (1)
Buckling length	L_{cr} = **3,300** mm	
Critical buckling moment	M_{CR} = **365** kNm	NCCI SN003b-EN-EU
Class 2 section, therefore use plastic modulus	W_{pl} = **497,000** mm^3	cl.6.3.2.1(3)
Non-dimensional slenderness ratio	$\bar{\lambda}_{LT}$ = **0.695**	cl.6.3.2.2 (1)
Depth to width ratio for buckling curve	h / b = **0.998**	
Buckling curve for h / b ratio	Buckling curve = **b**	Table 6.5 / BS-EN NA
Imperfection factor for buckling curve b	α_{LT} = **0.34**	Table 6.3 / BS-EN NA
Intermediate factor for reduction factor calculation	Φ_{LT} = **0.731**	cl.6.3.2.3 (1)
Buckling reduction factor	χ_{LT} = **0.872**	eq (6.57)
Correction factor for moment distribution	k_c = **1**	Table 6.6
Moment distribution modification factor	f = **1**	cl.6.3.2.3 (2)
Modified buckling reduction factor	$\chi_{LT,mod}$ = **0.872**	eq (6.58)
Design buckling resistance	$M_{b,Rd}$ = **154** kNm	eq (6.55)

Notes

C1 value conservatively taken as 1.0

Ends of beam are to be laterally restrained. Ends of beams can be laterally restrained using one of the following methods;

1) End of beam built into masonry wall.

2) End of beam fixed to a masonry wall.
3) End of beam fixed to a column or a beam.

The designer is to ensure that the proposed detail adequately ensures that the end of the beam is laterally restrained.

No allowance has been made for destabilising loads which are outside the scope of these calculations (Destabilising loads would not normally occur in a traditional masonry structure)

Padstone Calculator

COMPLIES WITH LATEST EUROPEAN DESIGN CODES

structural calculations for padstones

Beam End Reaction = **24.10** kN (factored) Variable Load Safety Factor = 1.5
Factored Load at End of Beam Permanent Load Safety Factor = 1.35

Characteristic strength of masonry = **2.8** N/mm² (Brickwork usually = 4.5 N/mm²)
(3.6N Blockwork usually = 2.6 N/mm²)
Width of beam end bearing = **100** mm (A Engineering Brick = 13.2 N/mm²)
Length of beam end bearing = **203** mm (B Engineering Brick = 10.5 N/mm²)
(Weak Brickwork = approx 2.8 N/mm²)
(7.3N Blockwork usually = 4.2 N/mm²)
(10.4N Blockwork usually = 5.4 N/mm²)

γm = 3.0

Bearing Factor = **1.25**

Results

Maximum Bearing Stress = 1.17 N/mm²
Actual Bearing Stress = 1.19 N/mm²

Padstone Required

Padstone Results

Characteristic strength of Padstone = **40.0** N/mm² (A Engineering Brick = 13.2 N/mm²)
(B Engineering Brick = 10.5 N/mm²)
Width of Padstone = **100** mm (Concrete C15 = 15 N/mm²)
Length of Padstone = **300** mm (Concrete C30 = 30 N/mm²)
(Concrete C40 = 40 N/mm²)
(Steel Plate = 275 N/mm²)

Allowable padstone stress = 16.67 N/mm²
Stress under beam end bearing = 1.19 N/mm² Therefore Padstone Stress OK
Allowable masonry stress = 1.17 N/mm²
Stress under padstone = 0.80 N/mm² Therefore Masonry Stress OK

40N/mm² Min' Compressive Strength Concrete Padstones
300mm long x 100mm wide x 140mm deep

Steel Beam to have a minimum end bearing length of 100mm

Padstones to Steel Beam